

The importance of organic matter and isotope studies by the Archean Biosphere Drilling Program

Hiroshi Naraoka[1]; Munetomo Nedachi[2]; Hiroshi Ohmoto[3]

[1] Dept. of Chem. Tokyo Metropolitan Univ.; [2] Space Sci., Kagoshima Univ.; [3] PSARC, Penn State

Early evolution of the earth's surface environment must have been closely related to the biological evolution. Microfossils and carbon isotopic compositions of Archean sedimentary rocks suggest that O₂-producing photoautotrophs such as cyanobacteria have been active since ~3.5Ga ago. However, the current popular idea postulates that the produced O₂ was completely consumed by reduced volcanic gases, resulting in an essentially O₂-free atmosphere until ~2.2Ga. Archean sedimentary rocks will provide crucial evidence for environmental evolution of the early earth. In particular, organic matters including biomarkers as well as carbon, nitrogen and sulfur isotopic compositions from the sedimentary rocks have been inferred to evaluate various bacterial activities associated with redox changes. So far, outcrop samples have been used for such studies. However, in the outcrop, sulfide sulfur is leached out as native sulfur to sulfate by modern oxidative weathering. While abundant pyrite nodules are observed core shale samples, little pyrite nodules are not observed in the outcrop shales. Using outcrop samples, sulfur concentration is estimated to be much less than original concentration. Moreover, the resultant sulfuric acid by the weathering also oxidizes sedimentary organic matter.

Since 2003, Archean Biosphere Drilling Program (ABDP) headed by Prof. Nedachi of Kagoshima University has started to drill out several core samples in the Pilbara and Hamersley districts, in co-operation with University of Western Australia, Geological Survey of Western Australia, and NASA Astrobiology Institute (NAI). In this talk, I will summarize the signatures of Archean organic matter including biomarkers with their chemical and isotopic compositions. In addition, the importance of the ABDP is also described for such organic matter and isotope studies of Archean sedimentary rocks.